Common Core State Standards for Mathematics and the Role of Smarter Balanced Assessment Consortium (SBAC)

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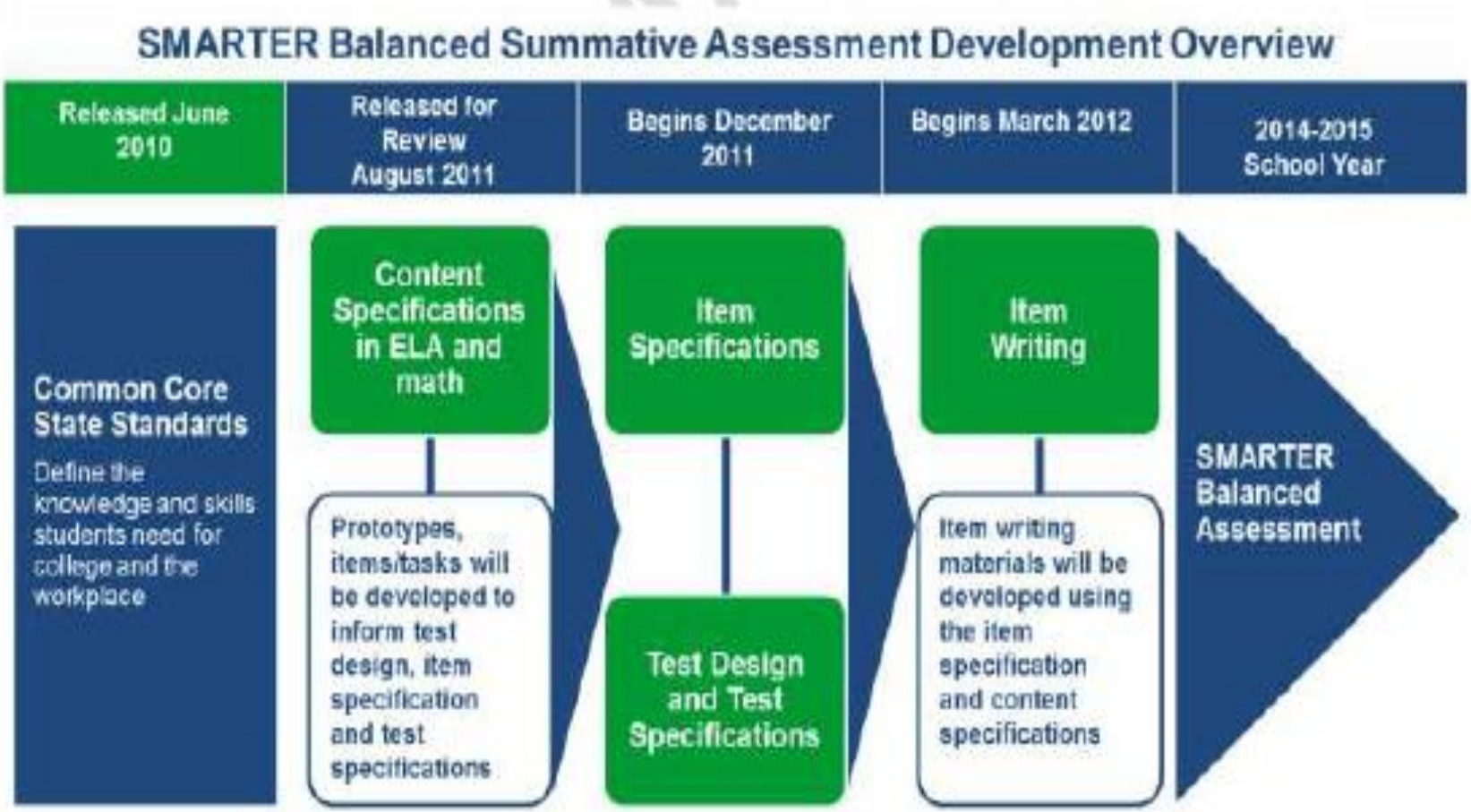
Assessment 2014-15 and Beyond:

SMARTER Balanced Assessment Consortium (SBAC)

Smarterbalanced.org



The Consortium Theory of Action for Assessment Systems: As stated in the SMARTER Balanced Assessment Consortium's (SMARTER Balanced) Race to the Top proposal, "the Consortium's Theory of Action calls for full integration of the learning and assessment systems, leading to more informed

* March 4, 2011 – “Eligible Content”
* March 20, 2012 – “Content Specifications”
* January 4, 2012 – “Item Specifications: Showcase 1”
* January 26, 2012 – “Item Specifications: Showcase 2”
* February 28, 2012 – “Item Specifications: Showcase 3”

* SBAC : Smarterbalanced.org

*Proposed, Tentative,

Draft Information about

the Administration of the

Assessment

Assessment System Components

- Summative assessments
  - Computer-Adaptive
  - Performance task(s)
- Optional interim assessments
- Formative assessment

Why Computer Adaptive Testing?

* Good information for teachers when used as interim assessments
* More efficient and more secure
* More accurate way to evaluate student achievement and to measure growth over time
* Efficient and precise measurement across the full range of achievement
* Quick turnaround of results

Fiscal Impact

* SBAC and PARCC are collaborating in a survey for every school in the nation to provide their computer capabilities.

* The results of the survey will be used to calculate costs for districts to become computer-ready for online testing.

Summative

* Mandatory
* 12-week window
* Grades 3-8 and 11
* Measures progress toward college- and career-readiness
* For three years, paper/pencil tests available

Summative (continued)

* Computer Adaptive (CAT)
  * Selected Response (SR)
  * Constructed Response (CR)
  * Technology Enhanced (TE)
* Performance Tasks (PT)
  * May include Extended Constructed Response (ER)

Interim

* Optional
* Include CAT and PT
* Results on the same scale as the summative
* Publicly released items and tasks (not secure!)
* Use learning progressions across grades
* Involve a large teacher role in developing and scoring
* Locally selected item sets
* Locally determined intervals

Formative

* Tools and processes
* Resources for teachers on how to collect and use information about student success in acquisition of the CCSS
* Used by teachers throughout the year

Types of items

- Selected response
- Short Constructed Response
- Extended Constructed Response
- Performance Task
- Technology-Enhanced

Selected Response

1. Select a single option from among a set of options (traditional multiple-choice)
2. Select multiple options from among a set of options
3. Create a line
4. Move one or more objects to given set of locations (drag-and-drop)

Selected Response:

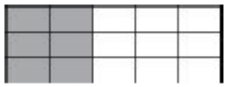
* From "Item Specifications"
  * with rubric

Figure 2.

For numbers 1a-1d, state whether or not each figure has $\frac{2}{5}$ of its whole shaded.

1a.  (Y) Yes (N) No

1b.  (Y) Yes (N) No

1c.  (Y) Yes (N) No

1d.  (Y) Yes (N) No

Figure 3.

Scoring Rubric

Responses to this item will receive 0-2 points, based upon the following:

2 points: YNYN The student has a solid understanding of 2/5 as well as the equivalent form of 2/5.

1 point: YNNN, YYNN, YYYN The student has only a basic understanding of 2/5. Either the student doesn't recognize an equivalent fraction for 2/5 or doesn't understand that all 5 parts must be equal-sized in figure 1b.

0 points: YYYY, YNNY, NNNN, NNYY, NYYN, NYNN, NYYY, NYNN, NNNN, NYNY, NNYN, NNNY The student demonstrates inconsistent understanding of 2/5 or answers "Y" to figure 1d, clearly showing a misunderstanding of what 2/5 means. Figure 1d is considered a "disqualifier" and an answer of "Y" to this part of the item would cancel out any other correct responses as "guesses" on the part of the student.

Constructed Response

* CRs that can be computer scored assigned to the CAT.
* Extended CRs assigned to ECR or to PT.
* Expected to include concepts detailed in the CCSS of lower grades
* Reading level approximately one grade level below the grade level of the test, except for specifically assessed mathematical terms

CAT Constructed Response

1. Enter a text String (traditional open-response)
2. Create a line
3. Produce a geometric shape

Performance Tasks

* multiple standards, claims and targets
* depth of understanding, research skills and/or complex analysis with relevant evidence
* student-initiated planning
* feasible for the classroom, up to 2 class periods
* oral presentations, exhibitions, product development, or more extended written responses
* real-world tasks
* multiple approaches
* relevant content
* 21st century skills
* scoring that focuses on the essence of the task

*Technology Enhanced Items (TEI):

- *Computer delivered items
- *Specialized interactions for response
- *interactions/responses that are not selected response
- *interactions/responses that are not text entry
- *may include digital media as the stimulus (sound, video, or interactive widget)

Table 23. Item Types by Which Eligible Mathematics Standards Were Judged to Be Measurable

Grade or Conceptual Category	Total	Selected Response		Extended Constructed Response		Technology Enhanced		Performance Task	
		Y	N	Y	N	Y	N	Y	N
3	25	24	1	25	0	25	0	25	0
4	28	28	0	28	0	28	0	28	0
5	26	26	0	26	0	26	0	26	0
6	29	29	0	29	0	29	0	29	0
7	24	23	1	24	0	24	0	24	0
8	27	27	0	27	0	27	0	27	0
Number and Quantity	9	8	1	9	0	9	0	9	0
Algebra	23	22	1	23	0	23	0	23	0
Functions	22	21	1	22	0	22	0	22	0
Geometry	35	23	12	35	0	35	0	35	0
Statistics and Probability	22	21	1	22	0	22	0	22	0
TOTAL	**270**	**252**	**18**	**270**	**0**	**270**	**0**	**270**	**0**
Percent of Total		**93%**	**7%**	**100%**	**0%**	**100%**	**0%**	**100%**	**0%**

Of the 270 eligible standards, 252 were judged to be assessable via all four item types. All 270 standards were judged to be assessable via extended constructed-response items, technology-enhanced items, and performance tasks. Eighteen standards were judged to be not measurable via selected-response items. Of the 18 standards, one was in grade 3, one was in grade 7, and the remaining 16 were in high school. Twelve of those high school standards were in the Geometry conceptual category.

Questions so far??

*Information about the Content of the Assessment

Table 24. Depth of Knowledge Levels of All Mathematics Standards

Grade or Conceptual Category	Total	Depth of Knowledge Level			
		1	2	3	4
3	25	24	24	3	0
4	28	28	16	5	0
5	26	26	18	3	0
6	29	29	20	2	0
7	24	18	22	8	0
8	28	26	25	9	0
Number and Quantity	27	27	15	0	0
Algebra	27	26	21	7	0
Functions	28	27	24	4	0
Geometry	43	24	36	19	1
Statistics and Probability	31	27	29	7	0
TOTAL	**316**	**282**	**250**	**67**	**1**
Percentage of Total Standards at DOK Level (Standards may cover a range of DOK levels)		**89%**	**79%**	**21%**	**< 1%**

Evidence-Centered Design (ECD)

- Evidence Centered Design used by the SMARTER Balanced Assessment Consortium
- SBAC established four Claims regarding what students should know and be able to do
- Claims are accompanied by
  - kinds of evidence that would be sufficient
  - evidence statements articulated as assessment targets.

Claims

- Claims are broad statements of the Assessment System's outcomes.
- Claims reorganize/combine standard statements.
- The Rationale presents both the scope of the claim and its connection and alignment to the CCSS.
- Content of standard is ***not*** changed.

Think:

integrating skills and concepts

versus

tapping only isolated skills in one strand

*Claims

Claim for Mathematics Summative Assessment - Overall

Grades 3-8

* —Students can demonstrate progress toward college and career readiness in mathematics.

Grade 11

* —Students can demonstrate college and career readiness in mathematics.

Claims for Mathematics Summative Assessment	
Claim #1	Concepts & Procedures "Students can explain and apply mathematical concepts and interpret and carry out mathematical procedures with precision and fluency."
Claim #2	Problem Solving "Students can solve a range of complex well-posed problems in pure and applied mathematics, making productive use of knowledge and problem solving strategies."
Claim #3	Communicating Reasoning "Students can clearly and precisely construct viable arguments to support their own reasoning and to critique the reasoning of others."
Claim #4	Modeling and Data Analysis "Students can analyze complex, real-world scenarios and can construct and use mathematical models to interpret and solve problems."

*SBAC Claims

* procedural skills
* conceptual understanding
* making the connection to these mathematical practices:
  * Use appropriate tools strategically.
  * Attend to precision.
  * Look for and make use of structure.
  * Look for and express regularity in repeated reasoning.

Claim 1 — Students can explain and apply mathematical concepts and interpret and carry out mathematical procedures with precision and fluency.

* Cluster headings serve as assessment targets for Claim 1.
* Note: **Only** Claim 1 Specification Tables directly connect to the content domains and clusters of CCSS-Math.
* Items for Claims 2-4 rely on the content from Claim 1, but are not necessarily directly connected.

* *Claim 1* – Students can explain and apply mathematical concepts and interpret and carry out mathematical procedures with precision and fluency.

Content emphases in the standards:

- Not all content is emphasized equally.
  - Major work of each grade (m)
  - Supportive of the areas of major emphasis (s)
  - Topics that may not connect tightly to the major work of the grade called additional (a)

Content Priorities for Assessing High School Students' College and Career Readiness

First Priority	Second Priority	Third Priority
Number and Quantity • Reason quantitatively and use units to solve problems • Extend the properties of exponents to rational exponents **Algebra** • Interpret the structure of expressions • Write expressions in equivalent forms to solve problems • Solve equations and inequalities in one variable • Understand solving equations as a process of reasoning and explain the reasoning • Create equations that describe numbers or relationships • Represent and solve equations and inequalities graphically **Functions** • Understand the concept of a function and use function notation	**Algebra** • Perform arithmetic operations on polynomials **Functions** • Interpret functions that arise in applications in terms of a context • Build a function that models a relationship between two quantities **Geometry** • Define trigonometric ratios and solve problems involving right triangles **Statistics and Probability** • Summarize, represent, and interpret data on a single count or measurement variable	*Clusters not appearing in the two columns to the left are of third priority. CCSSM content standards included in assessment targets are eligible to be assessed.*

* **Essential properties of items and tasks that assess Claim 1:**
  * **Selected response items,** including computer-enhanced items
  * **Short Constructed response** items
  * **Highly scaffolded tasks**
  * **Extended Response** items
    * **Application tasks**
    * **Translation tasks**
    * **Explanation tasks**

* *Claim 1* — Students can explain and apply mathematical concepts and interpret and carry out mathematical procedures with precision and fluency.

Claim 1 Number and Quantity

- **Target A [a/s]: Extend the properties of exponents to rational exponents. (DOK 1, 2)**
  - rewrite expressions involving radicals and rational exponents (Claim 1)

* **Target B [a/s]: Use properties of rational and irrational numbers. (DOK 1, 2)**
* demonstrate understanding of operations with rational and irrational numbers leading to generalizations about their sums and products
* provide concrete examples (e.g., give or choose three examples to show that the sum of two rational numbers is rational)
* Provide abstract generalizations (e.g., reasoning related to understanding that the sum of any two rational numbers is rational)

* Claim 1 Number and Quantity

Claim 1 Number and Quantity

- **Target C [m]: Reason quantitatively and use units to solve problems. (DOK 1, 2)**
  - choose and interpret units in formulas and the scale in a graph
- **Target D, E, F, G, H, I, J, K, L, M, N, O, P**
  - Many of the clusters from CCSS
- Clusters not highlighted for Claim 1 may be used to build tasks for Claims 2-4.

* Target A: Apply mathematics to solve well-posed problems arising in everyday life, society, and the workplace. (DOK 2, 3)
* Target B: Select and use appropriate tools strategically.
* Target C: Interpret results in the context of a situation. (DOK 2)
* Target D: Identify important quantities in a practical situation and map their relationships (e.g., using diagrams, two-way tables, graphs, flowcharts, or formulas). (DOK 1, 2, 3)

* *Claim 2* — Students can solve a range of complex, well-posed problems in pure and applied mathematics, making productive use of knowledge and problem-solving strategies.

* Target A: Test conjectures with specific examples. (DOK 2)
* Target B: Construct chains of reasoning that will justify or refute conjectures. (DOK 3, 4).
* Target C: State logical assumptions being used. (DOK 2, 3)
* Target D: Break an argument into cases. (DOK 2, 3)
* Target E: Distinguish correct logic from that which is flawed and—if there is a flaw in the argument—explain what it is. (DOK 2, 3, 4)
* Target F: Base arguments on concrete referents. (DOK 2, 3)
* Target G: At later grades, determine conditions under which an argument does and does not apply. (DOK 3, 4)

* *Claim 3* – Students can clearly and precisely construct viable arguments to support their own reasoning and to critique the reasoning of others.

* Problems not neatly “packaged.”
  * complex
  * insufficient or superfluous data.
* Tasks involve formulating a model
  * make assumptions and simplifications
  * select from the data at hand or estimate data that are missing
* Distinct from the well-formulated problem-solving tasks described in Claim 2
* Identify variables and construct relationships between them
* Interpret results and check the results for reasonableness

* *Claim 4* — Students can analyze complex, real-world scenarios and can construct and use mathematical models to interpret and solve problems.

* involve more than one content domain
* draw upon knowledge from previous grades (especially the “major” work of previous grades)
* performance tasks (each lasting up to 120 minutes)
* may be a collection of 3 to 5 extended-response items/tasks

* *Claim 4* — Students can analyze complex, real-world scenarios and can construct and use mathematical models to interpret and solve problems.

*From Showcase 2

Claim 1: Conceptual Understanding and Procedural Fluency
Students can explain and apply mathematical concepts and carry out mathematical procedures with precision and fluency.

Content Domain: **Number and Quantity**

Target C: Reason quantitatively and use units to solve problems.

Tasks for this target will require students to choose and interpret units in formulas and the scale in a graph. In Claims 2-4, this reasoning will be extended to include defining appropriate quantities when modeling and choosing appropriate levels of accuracy for units in the context of a real or mathematical problem (e.g., explaining the effects of rounding n to the nearest whole number in an area calculation).

Standards:	N-Q.1
DOK target(s):	1, 2
Evidence required:	1. The student chooses appropriate units of measurement in formulas. 2. The student interprets units of measurement in formulas, including units used in dimensional analysis. 3. The student chooses the scale in a graph. 4. The student interprets the scale in a graph.
Allowable item types*:	SR, CR, TE
Task Models:	1. SR (DOK 1) **Prompt Features 1:** The student is prompted to identify an appropriate unit of measurement in a formula calculation when given measurements in different units. **Prompt Features 2:** The student is prompted to identify the correct unit that will result from a formula calculation. **Prompt Features 2:** The student is prompted to identify conversion factors used in dimensional analysis. **Stimuli 1:** The student is presented with a set of measurements that are not in the same units. (e.g. rectangular prism dimensions: length 3 ft 5 in., width 16 in., height 1 yd 1 ft; options for volume units: cm, in., m, yd, ft^2, $in.^2$, km^2, yd^3, cm^3, ft^3) **Stimuli 2:** The student is presented with a rate that is to be converted. (e.g. miles per hour to feet per second) 1. CR (DOK 1, 2) **Prompt Features 1:** The student is prompted to determine an

*From Item Specs SC 2

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Mathematics Sample SR Item

Sample Item ID:	MAT.HS.TE.1.0NUMQ.C.083
Grade:	HS
Claim(s):	1: Students can explain and apply mathematical concepts and carry out mathematical procedures with precision and fluency.
Assessment Target(s):	**Target C: Reason quantitatively and use units to solve problems.** Tasks for this target will require students to choose and interpret units in formulas and the scale in a graph. In Claims 2-4, this reasoning will be extended to include defining appropriate quantities when modeling and choosing appropriate levels of accuracy for units in the context of a real or mathematical problem (e.g., explaining the effects of rounding n to the nearest whole number in an area calculation).
Content Domain:	Number and Quantity: Quantities
Standard(s):	N-Q.1
Mathematical Practice(s):	1, 2, 7
DOK:	1
Item Type:	TE
Score Points:	1
Difficulty:	L
Key:	$\frac{1000\ mL}{1\ L}$ and $\frac{1\ kg}{1000\ g}$
Stimulus/Source:	
Target-specific Attributes (e.g., accessibility issues):	
Notes:	Multi-item task

An object has a density measured in $\frac{g}{mL}$. The equation below models the conversion of this measure to $\frac{kg}{L}$.

$$\frac{g}{mL} \times \underline{\quad 1 \quad} \times \underline{\quad 2 \quad} = \underline{\qquad} \frac{kg}{L}$$

From the set of choices in the box below, select the correct unit ratios that belong on line 1 and line 2 of the equation.

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Mathematics Item Specification
Grade HS

Primary Claim 3: Communicating Reasoning
Students can clearly and precisely construct viable arguments to support their own reasoning and to critique the reasoning

Secondary Claim(s): Tasks wi
content targets. Related Clain
form. If Claim 2 or Claim 4 ta
Claim 1 targets in order of pr

Primary Content Domain: Eac
content focus. The content sh
progression of standards lead

Secondary Content Domain(s
content focus, components of
domains that a separate listin
appropriate.

Assessment Targets: Any give
assessment targets; each of t
targets should be listed in ord

Target A: Test propositions
Tasks used to assess this targ
proposition or conjecture (e.g
why/how…").

Target B: Construct, auton
propositions or conjecture
Tasks used to assess this targ
or refute a conjecture. Tasks
Target A as part of this reaso
tasks that assess Target A alo

Some tasks for this target wil

Target C: State logical assu
Tasks used to assess this targ
and previously established res
require students to provide m
estimate.

Target D: Use the techniqu
Tasks used to assess this target should ask students to determine u
argument is true, to determine under what conditions an argument

Mathematics Item Specification

Target F: Base arguments on concret
and actions. (DOK 2, 3)
In earlier grades, the desired student res
later grades, concrete referents will often
rather than constituting the entire expect

Target G: At later grades, determine
does not apply. (For example, area i
all plane figures.) (DOK 3, 4)
Tasks used to assess this target will ask s
conjecture always applies, sometimes ap
support their conclusions. Targets A and
evidence for Target G.

Relevant Verbs	Understand, exp analyze
DOK target(s):	2, 3, 4
Claim 3 Rationale:	**Mathematical** **critique the re** • Understand previously • Make conj explore the • Analyze sit • Recognize • Justify thei respond to • Reason ind take into a • Compare t • Distinguish and, if ther ○ Eleme refere ○ Secon argum

Mathematics Item Specification
Balanced Assessment Consorti

	• Calculate accurately and efficiently, express numerical answ with a degree of precision appropriate for the problem cont ○ In the elementary grades, students give carefully form explanations to each other. ○ In high school, students have learned to examine claim make explicit use of definitions.
Allowable item types*:	CR, ER, TE
Task Models:	**Proof and justification tasks:** These begin with a proposition the task is to provide a reasoned argument why the proposition not true. In some tasks, students may be asked to characterize domain for which the proposition is true. **Critiquing tasks:** Some flawed reasoning is presented and the is to correct and improve it. **Mathematical investigations:** Students are presented with a phenomenon and are invited to formulate conjectures about it. T are then asked to prove one of their conjectures. This kind of tas benefits from a longer time scale (from about 20 minutes to a lo performance task that may extend over more than one class per
Allowable manipulative materials:	protractor, ruler, calculator
Key non-targeted constructs:	While a high level of linguistic ability is associated with Claim 3 t students should not be penalized for weaknesses in written expressions (i.e., spelling, punctuation). It is desirable for studer be able to demonstrate reasoning or model an argument via sym geometric shapes, tables, diagrams, structured mathematical responses, technology-enhanced tools, etc.
Claim-specific attributes:	Tasks should be designed to take 10-20 minutes to solve. The computational demand on these tasks should focus on the s level typically expected for Claim 1 tasks for grades lower than 11, yet be consistent with the content domain emphases of Grad
Accessibility concerns:	Problems involving proofs and conjectures may sometimes be te heavy. Translation tools and dictionaries should be available to E students. Text readers should be available to blind or low-vision students.
Sample items:	045

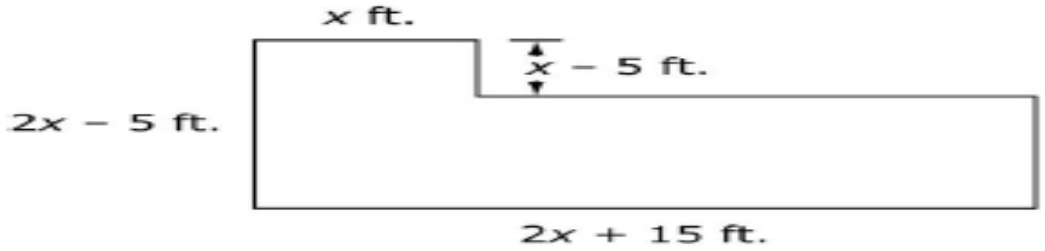
*SR = selected-response item; CR = constructed-response item; TE = technology-enhanc

Performance Task from "Item Specifications"

Sample Item ID:	MAT.HS.ER.3.0AAPR.F.045
Grade:	HS
Claim:	**Claim 3. Communicating Reasoning** Students can clearly and precisely construct viable arguments to support their own reasoning and to critique the reasoning of others.
Secondary Claim(s):	Claim 1: Conceptual Understanding and Procedural Fluency Students can explain and apply mathematical concepts and carry out mathematical procedures with precision and fluency.
Content Domain:	Algebra: Arithmetic with Polynomials and Rational Expressions
Assessment Target(s):	F: Base arguments on concrete referents such as objects, drawings, diagrams, and actions. (DOK 2, 3)
Standard(s):	A-APR.1
Mathematical Practice(s):	1, 2, 6
DOK:	3
Item Type:	ER
Score Points:	3
Difficulty:	H
Key:	See rubric
Stimulus/Source:	
Target-specific Attributes (e.g., accessibility issues):	
Notes:	

Part A

Matthew plays a strategy game. The outline below represents the territory he starts with.

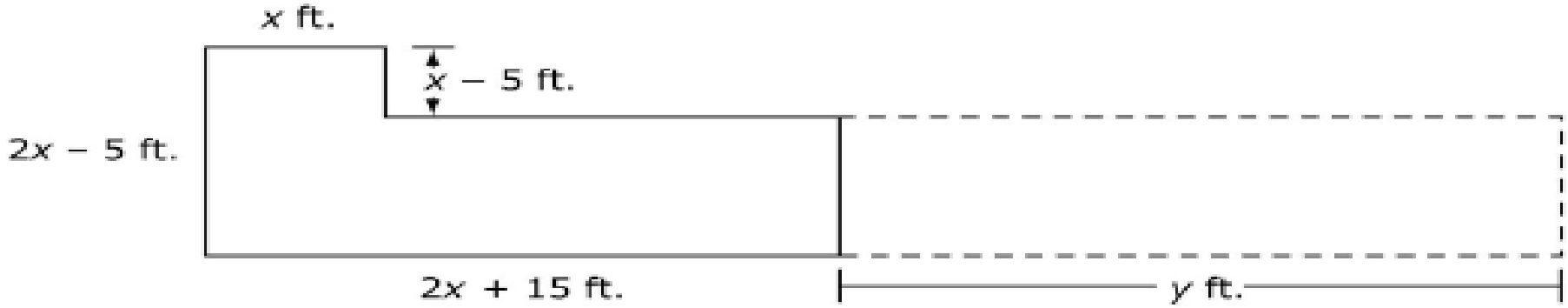


Write an expression for the area, in square feet, of this territory.

Show your work or explain your reasoning.

Part B

Matthew wants to double the area of his territory by the end of the game. He creates two plans to do this. The first plan increases the length of the lower portion of the territory by y feet, as shown in the diagram below.



Write an expression in terms of x to represent the value of y, in feet. Show your work or explain your reasoning.

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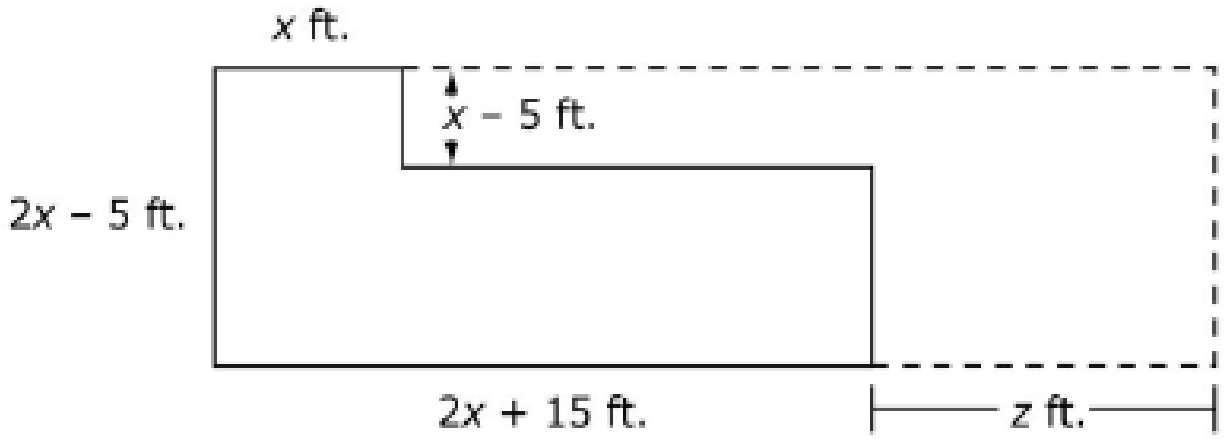
Part C

Matthew's second plan changes the shape of the territory to a rectangle, as shown in the diagram below.



Explain whether the value of z can be represented as a polynomial with integer coefficients. Justify your reasoning.

Proposed Reporting Categories for Summative Grades 3 - 8

* Overall Claim: Progress toward College and Career Readiness (Composite Score)
* Claim #1: Concepts and Procedures Score
* Claim #2: Problem Solving Score
* Claim #3: Communicating Reasoning Score
* Claim #4: Modeling and Data Analysis Score

Proposed Reporting Categories for Summative High School

* Overall Claim: College and Career Readiness (Composite Score)
* Claim #1: Concepts and Procedures Score
* Claim #2: Problem Solving Score
* Claim #3: Communicating Reasoning Score
* Claim #4: Modeling and Data Analysis Score

Table 22. Number of Mathematics CCSS Eligible for Summative Assessment

Grade or Conceptual Category	Total	Learnable		Expected		Measurable		Eligible	
		Y	N	Y	N	Y	N	Y	N
3	25	25	0	25	0	25	0	25	0
4	28	28	0	28	0	28	0	28	0
5	26	26	0	26	0	26	0	26	0
6	29	29	0	29	0	29	0	29	0
7	24	24	0	24	0	24	0	24	0
8	28	28	0	28	0	27	1	27	1
Number and Quantity	27	27	0	9	18	27	0	9	18
Algebra	27	27	0	23	4	27	0	23	4
Functions	28	28	0	22	6	28	0	22	6
Geometry	43	43	0	37	6	41	2	35	8
Statistics and Probability	31	31	0	22	9	31	0	22	9
TOTAL	**316**	**316**	**0**	**273**	**43**	**313**	**3**	**270**	**46**
Percent of Total		**100%**	**0%**	**86%**	**14%**	**99%**	**1%**	**85%**	**15%**

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